MEDICAL ACCELERATOR PROJECT

Navy Contract Nonr-225(06)

NR 022 166

STATUS REPORT

1 June - 31 August 1953

M.L. Report No. 223

December, 1953

Microwave Laboratory
STANFORD UNIVERSITY
STANFORD, CALIFORNIA

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Contract Nonr-225(06)

1 June 1953 - 31 August 1953

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Drafting	9
Electronics Shop	717
Machine Shop	209

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None

x - Partial compensation from this contract for work during the period.

DEVELOPMENT OF 6 MEV LINEAR ACCELERATOR FOR MEDICAL AND RADIOGRAPHICAL APPLICATIONS

Status Report
1 June to 31 August 1953

I. INTRODUCTION

The original contract Nonr225(06) extended from 1 March 1952 to 30 November 1952. In the meantime the period of the contract was extended, but no funds were available for the period 1 October 1952 to 31 May 1953. Beginning 1 June 1953, funds were made available for another contract year and active work was resumed. This report covers the three-month period ending 31 August 1953 during which the important problems under study were the electron injection system, the buncher, and methods of producing a sealed-off accelerator. Progress on each of these three phases of the work is reported separately in the sections to follow:

II. ELECTRON GUN

Several different electron guns of the basic type described in section II of the Status Report for the period 1 June to 31 August 1952 have been tested. Focusing properties of the guns were studied by means of the test chamber which contains fluorescent screens to give visual indication of the beam size.

Figure 1 is a photograph of a gun which was made in accordance with the original electrolytic tank design and which has been tested under operating conditions. It gave a well-focused beam of 100 kv electrons, but the total beam current was smaller

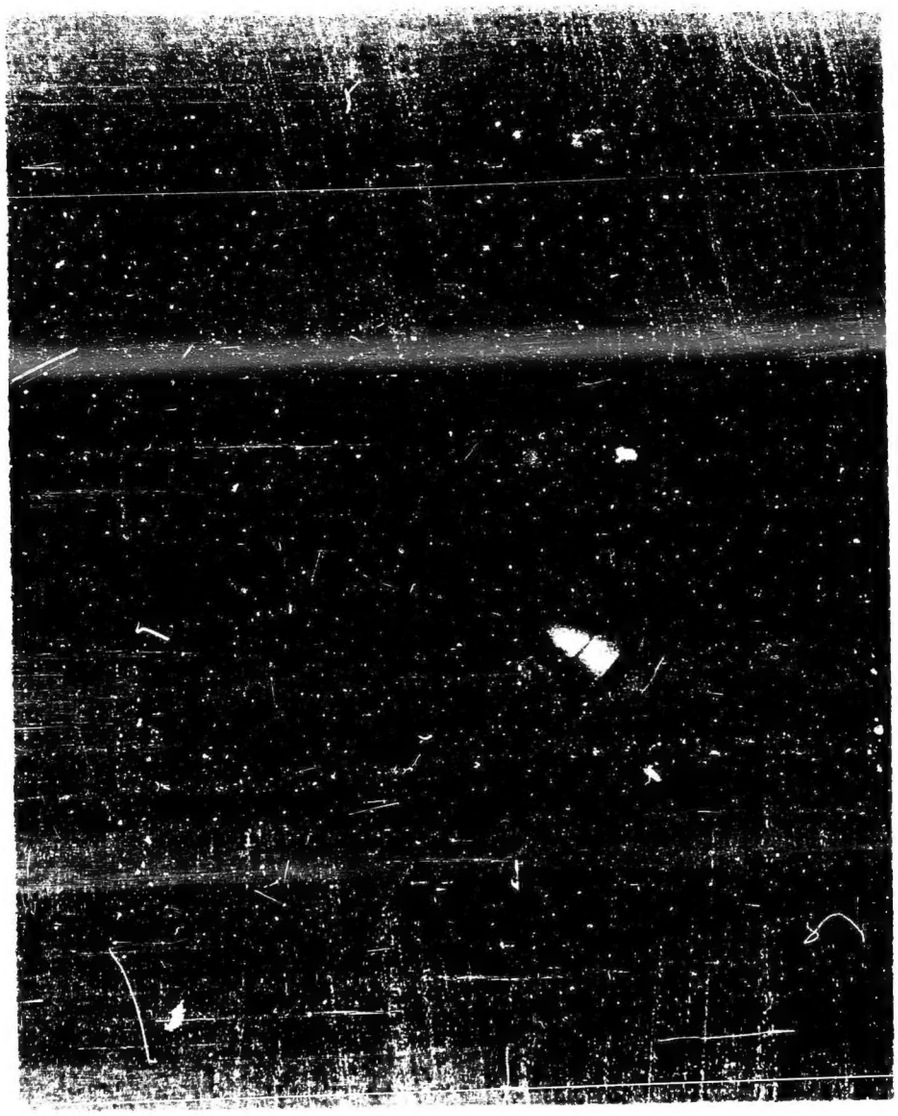

Fig. 1. Electron gun for the experimental medical accelerator.

than the design value. Experiments indicate that the current can be increased by improving the uniformity of the temperature distribution over the surface of the cathode, and by making slight changes in the geometry of the accelerating electrode nearest the cathode (No. 2).

III. BUNCHER

The first complete buncher was electroformed successfully into a single unit about 18 inches long. The electroformed wall was vacuum tight, but measurements with microwave test equipment showed that in some regions the phase shift per cavity deviated from the design value of $\pi/2$ by large amounts. Investigation into the cause of this error showed that it was not in any way due to the methods of fabrication but was caused by errors in design resulting from the test cavity measurements. On re-examining the test cavities used in the design of the buncher, it was found that the one simulating the input end of the buncher could be made to resonate in more than the three expected modes and that one of the spurious modes had been used in the design. When the correct mode was ascertained, the design was corrected and a second 18 inch bunching section was constructed.

The electroforming of the second buncher was as successful as that of the first, and the microwave tests of the second unit showed the phase shift curve to be correct within the tolerable errors in construction and measurement.

On the basis of these microwave measurements the best operating frequency for the buncher was about one megacycle

higher than the resonant frequencies of the test cavities which had been made for the uniform section. To bring the operating frequencies of the buncher and uniform section into correspondence, the inside diameter of the uniform section cavities will be made 3.246 inches instead of 3.247 inches, as reported in the status report for 1 September to 30 November 1952. A photograph of the second buncher is shown in Fig. 2.

IV. TECHNIQUES FOR PRODUCING A SEALED-OFF ACCELERATOR

The electroforming process for producing accelerator wave-guide has been very successful on all small sections. A tank tall enough to hold a vertical 6 foot section has produced good copper in several test runs on a 6 foot aluminum cylinder. It is therefore believed that a 6 foot accelerator, capable of being baked and sealed off, can be electroformed.

The method of gold diffusion sealing has been developed to provide means of sealing the target, gun, and coupler onto the accelerator wave guide.

In order to test the contemplated methods of sealing off the accelerator, it is planned to join the second experimental buncher (described in III of this report) onto two uniform sections of length 8 inches each by gold diffusion. A gun, coupler, and target will then be fastened to this short accelerator in order to produce a complete electron accelerator about 3 feet long. If this accelerator can be baked and sealed off, it will be almost certain that similar methods, applied to a larger unit, will be successful.

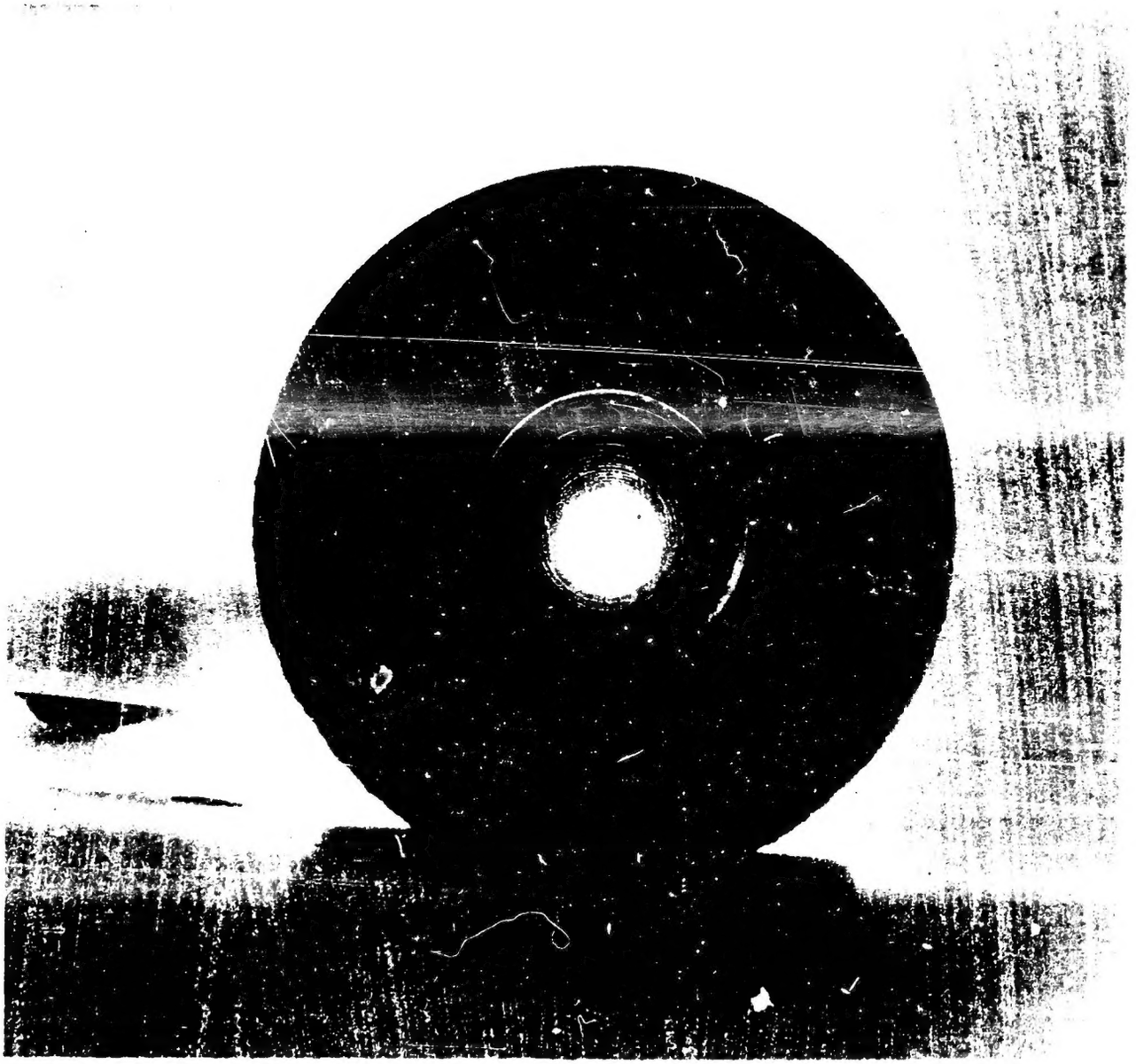

Fig. 2. View into entrance, experimental medical accelerator buncher.

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